Corporate governance, compensation mechanisms, and voluntary disclosure of carbon emissions: Evidence from Korea

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Abstract

We investigate the effects of incentive-alignment mechanisms on voluntary disclosure of carbon emissions in Korea, a latecomer in incorporating environmental practices into business operations. We consider in particular the effects of corporate governance and compensation mechanisms. We find that international aspects of governance mechanisms, measured by foreign ownership and cross-listing, are positively associated with the likelihood that a firm discloses carbon emissions voluntarily. Similarly, strong internal governance, measured by board independence and gender diversity, makes voluntary carbon emissions disclosure more likely. Moreover, firms that employ compensation schemes that explicitly align corporate social responsibility with CEO pay and those that set carbon emissions targets, which may be used to define thresholds for CEO bonuses, are more likely to voluntarily disclose carbon emissions. As such, both international influence and internal factors that affect corporate governance and compensation structures, all of which are well-known incentive-alignment mechanisms, play important roles in voluntary carbon emissions disclosure decisions in emerging markets.

Keywords: Carbon emission, Voluntary disclosures, Corporate governance, CEO compensation

JEL classification: G30, G32, Q56

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1. Introduction

While South Korea has experienced rapid economic expansion over the past few decades, it has also left an enormous carbon emissions footprint, ranking 17th in cumulative carbon dioxide emissions among 219 countries (Ritchie and Roser 2020). Following green actions taken in developed markets, Korea recently unveiled its own Green New Deal in 2020 with the goal of transitioning to a low-carbon and green economy. In particular, the Korean government announced step-by-step plans to improve corporate disclosure rules for public firms. The first step encourages firms to publish 'sustainability reports' voluntarily by 2025. The second step requires public firms with total assets valued at over two trillion Korean won (equivalent to approximately two billion US dollars) to disclose environmental, social, and governance (ESG) activities beginning in 2025, and the last step is a mandatory disclosure requirement that applies to all firms listed on the Korea Composite Stock Price Index (KOSPI) beginning in 2030. Although several years remain before the mandatory disclosure requirement takes effect, a number of Korean firms have already adopted voluntary disclosure of carbon emissions. In this paper, we explore the characteristics of Korean firms that voluntarily disclose carbon emissions to understand the factors that promote voluntary disclosure in emerging markets.

A number of prior studies analyze voluntary corporate disclosure of carbon emissions in Europe, the US, China, and Australia (Tsang, Xie, and Xin 2019; Liao, Luo, and Tang 2015; He, Zhou, Liu, and Yang 2021; Ben-Amar, Chang, and Mcllkenny 2017; Krishnamurti and Velayutham 2018; Jaggi, Allini, Macchioni, and Zagaria 2017). Factors that have been identified in prior studies that influence voluntary disclosure of carbon emissions include economic and social pressure (Luo, Lan, and Tang 2012), superior ESG performance (Kim, Kim, and Lee 2021), strong internal governance (Ben-Amar and Mcllkenny 2015), stock-based compensation (Nagar, Nanda, and Wysocki 2003), and ownership structure (Tsang, Xie, and Xin 2019). Despite a large number of studies that explore developed markets and China, voluntary corporate disclosure of carbon emissions in Korea merits investigation in its own right for several reasons. First, as mentioned above, South Korea is considered a latecomer with respect to incorporating ESG into business practices when compared with Western countries (Chapple and Moon 2005), despite its robust economic growth. Even large Korean firms such as chaebol have begun formulating ESG strategies within the past few years. ESG committees on boards and corporate ESG bonds barely existed until 2020, and a power purchase agreement (PPA) was not even available until October 2021. These phenomena suggest that the integration of climate risk into business planning remains in the earliest stages

for Korean firms. Consequently, drivers of voluntary carbon disclosures may differ from those that have emerged in developed markets.

Second, foreign investors own a large portion of Korean firms' shares. Most of these investors are based in Western countries and they tend to pay more attention to ESG issues (Brancato 1997; Chapple and Moon 2005; Oh, Chang, and Martynov 2011; Shu and Chiang 2020).[1] According to prior studies, foreign investors have been playing an important role in shaping corporate policies in Korean firms, weighing in on governance structures and CSR compliance (Oh, Chang, and Martynov 2011).

We hypothesize that, in the absence of mandatory disclosure requirements, managers in emerging-market firms have little incentive to disclose carbon emissions. This is because in emerging markets the costs of carbon disclosure likely exceed the benefits. For example, compared with other types of voluntary disclosure, carbon emissions disclosures can expose a firm to adverse consequences for their business operations (Coburn, Donahue, and Jayanti 2011; Krishnamurti and Velayutham 2018). Moreover, environmental reporting could leave firms vulnerable to costly lawsuits (Field, Lowry, and Shu 2005). Furthermore, Luo, Tang, and Lan's (2013) finding that the propensity to disclose emissions is positively associated with the resources that are available to a firm, particularly in developing nations, further suggests the costly consequences of voluntary disclosure of carbon emissions. On the other hand, carbon disclosure reduces information asymmetry between insiders and outsiders, which in developed markets could increase corporate value. Because investors in emerging markets typically pay limited attention to environmental issues or regard environmental efforts as costly, this benefit may not be significant in Korea.

We begin our analysis by investigating whether, in such an environment, international aspects from investors and compensation mechanisms influence voluntary disclosure of carbon emissions. We focus in particular on international attributes of corporate governance based on the important role that foreign investors, especially those based in Western countries, play in emerging markets. We additionally consider internal corporate governance and CEO compensation schemes. In a series of empirical analyses, we find that these incentive-alignment mechanisms enhance voluntary disclosure of carbon emissions. First, we find that international influence on corporate governance, measured by foreign investors' ownership and cross-listing, is positively associated with the propensity to disclose carbon emissions voluntarily. More

[1] The Korea Financial Supervisory Service reported, as of December 2021, the following portions of listed stocks held by foreign investors: the US, 40.3%; the UK, 8.4%; Luxembourg, 6.8%; Singapore, 6.8%; and Ireland, 4.3%.

interestingly, we provide evidence that European investors play the largest role among foreign investors in increasing the likelihood that Korean firms disclose emissions. We also consider the possibility that foreign investors invest in firms for which carbon information is publicly available. To test this possibility, we examine whether foreign ownership is higher in firms that are subject to mandatory disclosure of carbon emissions, but we find no such results.

Second, board independence and gender diversity on boards are positively associated with voluntary disclosure of carbon-emission information in Korea, which is also the case in developed markets. Third, the likelihood that carbon information is disclosed voluntarily is significantly higher when a manager's compensation package is aligned with ESG performance or when a firm sets emissions-reduction targets, which are likely aligned with bonus pay.

This paper adds to the growing body of literature that analyzes factors that drive voluntary disclosure of carbon emissions. As mentioned above, Luo, Lan, and Tang (2012) show that voluntary disclosure of carbon emissions increases when firms face social and economic pressure. Several studies show that firms that feature strong internal governance are more likely to disclose environmental information voluntarily (e.g. Tsang, Xie, and Xin 2019; Hope, Kang, and Kim 2013; Liao, Luo, and Tang 2015). Peng, Sum, and Luo (2015) find that firms are likely to follow their industry peers' behavior when they decide whether to disclose carbon emissions information. We add to this literature by providing evidence that, in emerging markets, corporate governance involving foreign investors plays an important role along with compensation schemes. In addition, we show that the origins or home countries of foreign investors matter. In particular, the results of our analysis imply that investors from countries that impose strict environmental standards transfer such practices to emerging markets.

Our paper also adds to the literature on compensation schemes and CSR. Previous research demonstrates the important role that executive compensation structures play when firms incorporate CSR practices into their strategies. Haque (2017) and Baraibar-Diez, Odriozola, and Sanchez (2019) show that CSR-connected compensation improves CSR performance. We add to this line of studies by suggesting that carbon disclosure, which is an essential step towards achieving low-carbon targets, is among the channels through which CSR-connected compensation influences CSR performance.

The rest of the paper proceeds as follows. In section 2, we introduce our hypotheses based on the related literature. In section 3, we describe the details pertaining to the data and the research design. Section 4 presents the empirical results regarding the determinants of voluntary disclosure of carbon emissions and section 5 concludes.

2. Literature review and hypothesis development

2-1 International governance mechanisms

Prior studies show that international aspects of corporate governance play an important role in emerging markets. Tsang, Xie, and Xin (2019) investigate the influence of foreign investors on voluntary disclosure policies in 32 non-US countries and show that foreign institutional investors do more than domestic institutional investors to spur firms to improve their voluntary disclosure practices. This is because foreign investors are unfamiliar with a host country's language, culture, and legal system, thereby facing high information asymmetry. Ezhilarasi and Kabra (2017) and Gerged (2021) also show that foreign institutional investors are positively associated with disclosure of environmental information in India and Jordan, respectively. On the other hand, several papers find that firms with higher foreign ownership shares are not necessarily more likely to disclose information about carbon emissions voluntarily in Canada (Wegener, Elayan, Felton, and Li, 2013) and China (Shen, Zheng, Adams, and Jaggi, 2020). In addition, Kılıç and Kuzey (2019a) and Shan, Tang, and Zhang (2021) show that foreign ownership is negatively associated with climate change-related disclosures in Turkey and Australia, respectively. Because foreign investors generally play an important role in Korea and Korea is a latecomer to incorporating ESG practices into business operations, we expect firms whose ownership structures include higher foreign ownership shares are likely to be more active in a voluntary disclosure of carbon emissions.

Another strand of literature shows that cross-listed firms are more likely to engage in voluntary disclosure practices. Chen, Dong, Ng, and Tsang (2019) find that cross-listed firms disclose more information voluntarily than non-cross-listed firms, especially when the differences in accounting standards between a home country and target countries are wider. Hope, Kang, and Kim (2013) find that cross-listing promotes voluntary disclosure by firms that are cross-listed on the US stock market by improving the information environment. In studies that are closely related to ours, Garanina and Array (2021) and Lu and Wang (2021) show that cross-listing encourages firms to voluntarily disclose CSR information, suggesting that they can enhance their accountability by disclosing such activities. As such, prior studies demonstrate that cross-listed firms are more likely to engage in voluntary disclosure of information, including CSR-related information.

Based on these studies, we conjecture that stronger international influence on corporate governance, proxied by foreign ownership and cross-listing, encourages firms to disclose carbon emissions voluntarily:

H1-a: Strong international influence on corporate governance is positively associated with the likelihood that firms disclose carbon emissions voluntarily.

Next, we examine how foreign investors across various geographical regions affect the likelihood that voluntary disclosure occurs. Dyck, Lins, Roth, and Wagner (2019) find that European investors drive the greatest improvement in environmental and social performance in foreign countries, whereas investors from other regions show insignificant effects. They suggest that foreign investors from countries featuring strong social norms focus more attention on sustainable performance than on financial returns. Meanwhile, Jo and Park (2020) document that a stronger negative CSR–risk relationship is evident for firms operating in Europe and North America than in the Asia-Pacific region, because European and American investors are likely to give more weight to engagement in CSR. We therefore propose that increases in voluntary disclosure of carbon emissions are more pronounced when European or American investors hold high ownership shares.

H1-b: Firms in which foreign investors based in Western countries hold higher ownership shares are more likely to disclose carbon emissions voluntarily.

2-2 Internal governance mechanisms and monitoring

Outside directors and inside directors are subject to quite different incentives and hold quite different values. Post, Rahman, and Rubow (2011) point out that outside directors are more likely to monitor managerial activities properly, while inside directors are less concerned with managers' opportunistic decisions because of their close ties with those managers. In addition, independent directors pay more attention to long-term goals such as sustainability, whereas internal directors pursue short-term objectives such as superior operating performance (Johnson and Greening 1999; Ibrahim and Angelidis 1995). Several studies find that firms place more value on climate-related challenges and opportunities when their boards include high proportions of outside directors (Post, Rahman, and Rubow 2011; Haque 2017) and report that these firms earn higher CSR scores (Wang and Coffey 1992).

With respect to voluntary disclosure of carbon emissions, Liao, Luo, and Tang (2015) show that, in the UK, the proportion of independent directors on a board is strongly correlated with disclosure propensity. Similar results are reported by prior studies set in several countries: Ben-

Amar and Mcllkenny (2015) in Canada; Jaggi, Allini, Macchioni, and Zagaria (2017) in Italy; Kılıç and Kuzey (2019b) in Turkey; and Elsayih, Tang, and Lan (2018) in Australia. These findings highlight the role of the structure of boards of directors in voluntary disclosure of carbon emissions.

Another stream of research investigates board gender diversity and voluntary disclosure of carbon emissions. Liao, Luo, and Tang (2015) analyze the largest companies in the UK and suggest that the presence of female directors plays a significant role in the voluntary disclosure of carbon emissions. He, Zhou, Liu, and Yang (2021) investigate listed Chinese firms in high-carbon industries and find a positive relationship between the presence of female directors and carbon emissions information disclosure. Ben-Amar, Chang, and Mcllkenny (2017) also find that the likelihood that voluntary carbon emissions disclosure occurs increases with the ratio of female board members. In addition, Elsayih, Tang, and Lan (2018) show that both board independence and board diversity positively affect carbon disclosure projects in Australia. Overall, prior studies generally find positive effects of board independence and board gender diversity on voluntary disclosure of carbon emissions but, to the best of our knowledge, no study has examined Korean firms.

Based on the above discussion, we conjecture that firms that institute strong internal governance mechanisms, such as high board independence and gender diversity, are likely to disclose carbon emissions voluntarily:

H2: Strong internal governance mechanisms, measured by board independence and gender diversity, are positively associated with the likelihood that voluntary disclosure of carbon emissions occurs.

2-3. Compensation schemes

As interest in ESG management continues to grow globally, firms are increasingly incorporating ESG factors into executive compensation. This practice has been on the rise in Korea as well. For example, SK Innovation, a firm that engages in petroleum production across the world, announced that it would link carbon emissions and ESG performance to executive compensation metrics.

Several studies focus on the effects of CSR-contingent executive compensation on CSR performance but find mixed results. For example, Hong, Li, and Minor (2016) show that the existence of compensation contracts tied to CSR in the US improves CSR performance.

Berrone and Gomez-Mejia (2009) highlight an insignificant relationship in the US between executive pay linked to environmental management and environmental performance. Haque (2017) finds a positive association between ESG-based compensation and carbon performance, suggesting that sustainable compensation policy motivates managers to address environmental concerns. To the best of our knowledge, the association between CSR-connected compensation and carbon disclosure is explored only by Luo, Wu, and Zhang (2021). Using firm-level data from 40 countries, the authors show that, when executive compensation is aligned with stakeholder interests, firms are encouraged to disclose corporate carbon transparency voluntarily. Moreover, the quality and comprehensiveness of carbon emissions disclosure are improved when a compensation scheme is linked to sustainability targets. The 40 countries covered by the study comprise mostly developed markets, and Korea, our country of interest, is not included.

Leading companies in carbon-intensive sectors such as oil and gas, mining, and steel have adopted executive compensation policies that underlie annual bonus pay (Ritz 2022). Liao, Luo, and Tang (2015) show that including short-term bonuses in compensation packages plays a significant role in inducing firms to disclose carbon-related information, whereas long-term bonuses do not. Ott and Endrikat (2022) find that firms that set carbon emissions targets are more likely to achieve superior carbon performance. There is, however, a lack of research on the association between carbon emissions targets and voluntary disclosure of carbon emissions. Because bonuses are commonly set against certain benchmarks, we expect that firms that set carbon emissions targets are likely to offer executives carbon-connected bonuses. Supporting this expectation, Winschel (2021) shows that carbon-related targets are used mainly to determine short-term executive compensation. In addition, Tang and Demeritt (2018) find that some managers in UK-listed firms are rewarded through bonuses if specified emissions-reduction targets are hit.

Based on the above discussion, we hypothesize that firms in which CEO compensation is connected to CSR performance are more likely to engage in voluntary disclosure activities. Similarly, firms that set specific targets for carbon emissions, which are likely used to structure CEO compensation contracts, are more likely to engage in voluntary disclosure of carbon emissions:

H3: Firms that employ executive compensation schemes that explicitly align CSR performance with CEO pay and those that set carbon emissions targets are more likely to disclose carbon

emissions voluntarily.

3. Data and research design

3.1. Research model

In this section, we provide the results of the tests of the abovementioned hypotheses. We begin by introducing a logit regression model that we use to examine the relationship between firm-level characteristics and voluntary carbon information disclosure, controlling for firm-level characteristics and industry or year fixed effects. The regression specification is shown below:

$$DisclosureD = \beta_1 \times FirmChar + \sum_{i=2}^{n} \beta_i \times Control + \text{Industry (or Year) Fixed effects}$$

DisclosureD is an indicator variable that equals one if a firm is a voluntary-disclosure firm and zero otherwise. In this model, a positive coefficient on β_1 implies that firms with this characteristic are more likely to disclose carbon emissions information voluntarily, whereas a negative coefficient suggests that those firms are less likely to disclose such information voluntarily.

3.2. Data and variables

We collect data on carbon emissions from the Thomson Reuters Eikon Database (hereafter Eikon), which is based on "voluntary" carbon information disclosure.[2] In addition, we retrieve "mandatory" carbon emissions disclosure data from the National Greenhouse Gases Management System (https://ngms.gir.go.kr/).[3] We gather primary firm-specific data from the FnGuide database. We obtain demographic data indicating each board member's gender from the Data Analysis, Retrieval and Transfer System (DART) provided by the Korean Financial Supervisory Service, and data indicating their positions from TS-2000.[4] We collect foreign ownership data on a region level from Eikon's shareholder reports.

[2] Eikon gathers CSR information, including carbon emissions data, from the company's Corporate Social Sustainability Report, the Carbon Disclosure Project Report, and publicly available documents on the company's website. These documents imply that the data are disclosed voluntarily, not out of a legal obligation.

[3] Korea's Framework Act on Low Carbon Green Growth stipulates that each controlled entity should prepare a statement reporting quantities of greenhouse gases emitted and quantities of energy consumed at each place of business and submit it to the government every year.

[4] Some firms do not report either gender or position of their directors, but we keep these firms for analyses that do not require director characteristics. In addition, the web-crawling API in the DART database is available only since 2013, so we use board demographic data from 2013 through 2019.

Larger firms are more likely to provide data to ESG databases held by the rating agencies (Drempetic, Klein, and Zwergel 2020), so we confine our attention to firms that are listed on the KOSPI 200 from 2011 through 2019. This enables us to uniformly compare the records of firms that report (and do not report) carbon information. We exclude financial firms because of the specific capital structure they generally share. In addition, we restrict the sample to firms with non-missing variables needed for the analyses. Our final sample includes 239 firms with 1,510 firm-year observations.

As proxies for incentive-alignment mechanisms, we first consider international factors. $ForeignOwn^{\%}$ represents ownership by foreign investors scaled by total ownership, and *CrossListingD* is an indicator variable that equals one if a firm is listed on foreign stock markets and zero otherwise. In addition, we classify foreign ownership by geographical regions. $Region^{\%}$ is defined as foreign investors' shares by the geographic regions in which they are based scaled by total ownership. The regions we consider are the following: Europe ($Europe^{\%}$), the US ($US^{\%}$), Asia ($Asia^{\%}$), Africa ($Africa^{\%}$), and Oceania ($Oceania^{\%}$). Second, $OutsideDir^{\%}$ ($FemaleDir^{\%}$) is calculated as the ratio of outsider directors (female directors) to total directors. Third, we consider compensation schemes, measured by ESG-linked compensation or target-setting. *ESGPayD* is an indicator variable that equals one if executive compensation metrics are based on ESG or sustainability factors and zero otherwise. Similarly, *TargetD* is also an indicator variable that equals one if a firm sets carbon emissions targets and zero otherwise.

Control variables are defined as follows. Firm size (*Size*) is the natural logarithm of total assets. Investment (*Investment*) is capital expenditures scaled by lagged total assets. Return volatility (*RETvol*) is the standard deviation of stock returns over the previous 52 weeks. Leverage (*Leverage*) is total liabilities divided by total assets. Tobin's Q (*Q*) is the sum of the market value of equity and total liabilities scaled by total assets. R&D ratio (*R&D*) is the ratio of research and development expenditures to sales. Lastly, *ManDisD* is an indicator variable that equals one if a firm is a mandatory-disclosure firm and zero otherwise. All variables are defined in Appendix I and winsorized at 1 percent on both tails of the distribution.

4. Empirical results

4.1. Summary statistics

We report summary statistics for sample firms from 2011 through 2019 in Table 1. In our sample, approximately 31.9% of the firms disclosed their carbon emissions voluntarily and 47.0% disclosed their carbon emissions in compliance with the mandate. In addition,

approximately 25.0% of sample firms set targets for carbon emissions (*TargetD*) and 11.1% of the sample firms deploy CEO contracts that are explicitly aligned with ESG performance (*ESGPayD*). These findings imply that Korean companies began focusing on environmental and CSR issues during the sample period. The average size of firms in the full sample is 21.85, which is equivalent to about 3,085 billion Korean won in total assets. Our sample firms' leverage ratio is on average 0.471 and the average Tobin's Q is 1.373.

Table 1 About Here

Table 2 displays the correlation coefficients of the variables in our analysis. We find that *DisclosureD*, our measure of voluntary disclosure of carbon emissions information, is strongly correlated with firm size (*Size*), return volatility (*RETvol*), and leverage (*Leverage*). These findings suggest that a firm with a high size, low return volatility, and high leverage has a positive correlation with its disposition to voluntarily disclose carbon emissions. In addition, the correlations between *DisclosureD* and foreign ownership ($ForeignOwn^{\%}$), cross-listing (*CrossListingD*), outside director ratio ($OutsideDir^{\%}$), and ESG-linked compensation (*ESGPayD*) are 0.33, 0.38, 0.39, and 0.49, respectively. These findings suggest that these factors are strongly correlated with voluntary disclosure of carbon emissions information. The correlations between *ManDisD* and these variables are weaker than those between *DisclosureD* and the same variables.

Table 2 About Here

4.2 International aspects of corporate governance

To test Hypothesis H1-a, we examine the association between the international aspects of corporate governance and voluntary disclosure of carbon emissions. Based on the research model presented in section 3, we report the results of the logit regressions in Table 3. For all columns the dependent variable is *DisclosureD*. The independent variable is $ForeignOwn^{\%}$ for columns (1) and (2) and *CrossListingD* for columns (3) and (4). To obtain the results reported in the odd-numbered columns we include industry fixed effects, and for the even-numbered columns we include both year and industry fixed effects. We cluster standard errors at the industry level in all regression specifications.

The coefficients on $ForeignOwn^{\%}$ are positive and statistically significant in both columns,

suggesting that foreign investors encourage Korean firms to disclose carbon emissions. The estimate reported in column (2) suggest that a one-standard-deviation increase in foreign ownership is associated with 0.41 higher log odds that voluntary disclosure occurs. Similarly, the coefficient on *CrossListingD* is positive and statistically significant in both columns, suggesting that cross-listed firms are more likely to engage in voluntary disclosure of carbon emissions. Regarding control variables, *Size* has a positive and significant coefficient in all columns. This result is consistent with prior studies that analyze the propensity to engage in carbon-related disclosure to carbon disclosure projects (Cui and Hwang 2018; Kim, Kim, and Lee 2021; Choi and Noh 2016). In addition, capital expenditures (*Invesetment*) are positively associated with the probability that carbon emissions are disclosed voluntarily, a finding that is consistent with Cui and Hwang (2018). The results imply overall that international aspects of governance induce firms to participate more actively in voluntary disclosure of carbon emissions, supporting Hypothesis 1-a.

Table 3 About Here

Next, we test Hypothesis 1-b, which proposes that ownership by investors from European countries and the US is positively associated with voluntary disclosure of carbon emissions. The results reported in Table 4 illustrate how foreign investors across various geographical regions affect the likelihood that carbon information is disclosed voluntarily. We include industry fixed effects and year fixed effects in all the regression analyses and standard errors are clustered at the industry level. The dependent variable is *DisclosureD*. The primary variable of interest is $Region^{\%}$. We first decompose foreign investors' nationality into five regions: Europe, the US, Asia, Africa, and Oceania. We then calculate the total share of foreign investors in each firm by reference to geographical region. The shares of European, American, Asian, African, and Oceanian investors are used in the analysis reported in columns (1), (2), (3), (4), and (5), respectively. Only the coefficient on $Region^{\%}$ reported in column (1) is positive and statistically significant at the 5%, whereas the coefficients reported in all the other columns are statistically insignificant. In particular, the estimate in column (1) implies that a one-standard-deviation increase in European ownership results in a 0.495 increase in the log odds that voluntary disclosure occurs. These results indicate overall that firms whose ownership structures include high shares owned by European investors, but not those representing the US or other regions, are likely to disclose environmental practices voluntarily. This finding implies

that European investors value CSR more highly than other region's investors, as a result of which they prefer investing in firms that engage actively in CSR (Hill, Ainscough, Shank, and Manullang 2007).

Table 4 About Here

A concern regarding the results provided in Tables 3 and 4 is that foreign investors face an informational disadvantage and thus may choose to invest in firms offering publicly available information about their carbon emissions. Similarly, one might argue that European investors especially prefer firms that make carbon information available publicly. To address these concerns, we repeat the logit regression analysis of mandatory disclosure of carbon emissions.

The Korean government launched the Target Management System (TMS) in 2010 and the Emissions Trading Scheme (ETS) in 2015. Designated firms must submit their annual target-setting and implementation plans for greenhouse gas emissions and energy consumption. Firms that fail to achieve their targets face administrative penalties. Most importantly for our purposes, firms that are assigned to the TMS and/or the ETS are required to disclose carbon emissions to the National Greenhouse Gas Emission Management System (NGMS).

In Table 5 we report the results of the analyses of the effects of mandatory disclosure of carbon emissions. If a firm is designated for the TMS or the ETS by the Korean government, we treat the firm's emissions disclosures as mandatory. The dependent variable is *ManDisD*, which is assigned the value of one if a firm is a mandatory-disclosure firm and zero otherwise. With respect to Panel A, the independent variables are foreign ownership ($ForeignOwn^{\%}$) for columns (1) and (2) and cross-listed status (*CrossListingD*) for columns (3) and (4). None of the coefficients on $ForeignOwn^{\%}$ and *CrossListingD* is statistically significant, suggesting that neither foreign ownership nor cross-listing is associated with mandatory disclosure of carbon emissions.

With respect to Panel B, we repeat the analysis associated with Table 4. The dependent variable is *ManDisD* and the variable of interest is $Region^{\%}$. Unlike the results presented in Table 4, here the association between the share of European investors and disclosure practice is statistically insignificant, as shown in column (1), implying that only voluntary disclosure of carbon emissions is significantly associated with ownership by European investors. Meanwhile, it is noteworthy that the association between mandatory disclosure of carbon emissions and ownership by Asian investors is positive and statistically significant, as shown in column (3).

This result implies that ownership of Asian investors, who likely face a less severe information disadvantage than non-Asian investors, is positively associated with mandatory disclosure of carbon emissions. In sum, we do not find evidence that foreign investors, especially European investors, pursue stocks issued by firms that make information on carbon emissions available publicly.[5]

Table 5 About Here

4.3 Internal corporate governance and monitoring

Next, we turn our attention to internal governance mechanisms and monitoring, which are measured by outside and female directors on boards. As proposed in Hypothesis 2, we expect to find that the propensity to disclose carbon emissions voluntarily will be more pronounced in firms that feature high board independence and gender diversity (Ben-Amar, Chang, and Mcllkenny 2017; Liao, Lui, and Tang 2015).

Table 6 displays the results. The dependent variable is *DisclosureD*. The independent variables are the share of outside directors ($OutsideDir^{\%}$) in columns (1) and (2) and the share of female directors ($FemaleDir^{\%}$) in columns (3) and (4). We include industry fixed effects in the analysis associated with columns (1) and (3), whereas we include both industry fixed effects and year fixed effects for columns (2) and (4). The coefficients on $OutsideDir^{\%}$ and $FemaleDir^{\%}$ are statistically significant and positive in all columns, suggesting that firms featuring higher shares of outside directors or female directors are more likely to voluntarily disclose carbon-related information. In terms of the magnitude of the coefficients reported in column (2) ((4)), a one-standard-deviation increase in the percentage of outside directors (female directors) produces, on average, a 0.42 (0.30) increase in the log odds that carbon emissions are disclosed voluntarily.

Overall, we conclude that strong internal governance and monitoring have a significant and positive effect on voluntary disclosure of carbon emissions, which is consistent with our expectations expressed in Hypothesis 2. We interpret these results to imply that firms can improve their environmental information disclosure practices through increased heterogeneity on boards, which seems to enhance decision-making from a variety of perspectives (Bear, Rahman, and Post 2010).

[5] We repeat all the logit analyses in this paper after replacing the voluntary disclosure dummy with the mandatory disclosure dummy. None of the coefficients of interest is statistically significant.

Table 6 About Here

4.4 Compensation schemes

In this section, we present the results of a logistic regression analysis that considers the effects of executive compensation schemes that are linked to CSR performance on voluntary disclosure of carbon emissions (Hypothesis 3). As in the previous analyses, here the dependent variable is *DisclosureD*. The main independent variables are *ESGPayD* and *TargetD* for columns (1)–(2) and (3)–(4), respectively. The estimated coefficient on *ESGPayD* in both columns is positive and significant at the 1% level, suggesting that ESG-oriented compensation policies encourage managers to disclose carbon information voluntarily. Furthermore, the estimated coefficient on *TargetD* in both columns is positive and significant. This finding implies that if a firm sets carbon emissions targets, which likely is linked to bonus compensation schemes, it is more likely to disclose carbon emissions voluntarily. In sum, firms that employ compensation policies underlying sustainability performance are more likely to disclose carbon emissions voluntarily.

Table 7 About Here

5. Conclusion

This paper examines the effects of incentive-alignment mechanisms on voluntary disclosure of carbon emissions in Korea. We focus on Korea first because this country is a latecomer to incorporating ESG practices into business operations. Lagging behind Western countries, Korea has highlighted the importance of ESG only recently and most Korean firms have begun to incorporate the associated practices into their business processes relatively recently. Moreover, foreign investors play a significant role in Korean firms. Because most foreign investors in Korean firms are based in Western countries where sensitivity to environmental issues has been higher than it has been in Korea for many years, they are more likely require firms to engage in ESG-related disclosure practices.

Using data from the Thomson Reuters Eikon Database for a period running from 2011 through 2019, we show that incentive-alignment mechanisms encourage firms to disclose their carbon-related information voluntarily. We introduce three categories of incentive-alignment mechanisms: international corporate governance, internal corporate governance, and executive

compensation schemes. Our main findings are as follows. First, with respect to international influence on corporate governance, foreign investors appear to encourage firms to disclose carbon emissions voluntarily. Moreover, this effect is driven mostly by the influence of European investors. Second, similar to findings from studies set in developed countries, we find that strong internal corporate governance, proxied by board independence and board gender diversity, positively affects the likelihood of voluntary disclosure of environmental information. Third, a CEO compensation contract that is aligned with CSR performance or the existence of carbon emissions targets amounts appears to encourage voluntary disclosure of carbon emissions.

This paper makes an important contribution to our understanding of environmental policies in emerging markets. Our results suggest that the influence of developed markets plays an important role in encouraging firms to adopt proactive environmental policies such as voluntary disclosure of carbon emissions. In addition, CSR-linked compensation schemes and carbon emissions target-setting appear to incentivize managers to make environmentally transparent decisions. Without mandatory disclosure requirements or such incentive-alignment mechanisms, it could be difficult to motivate firms in emerging markets to engage in environmentally transparent actions voluntarily.

This reluctance may be partly due to the characteristics of disclosure of carbon emissions. Perhaps to a greater extent than is the case with other types of voluntary disclosure, disclosing carbon emissions can expose firms to adverse consequences for their business operations (Coburn, Donahue, and Jayanti 2011; Krishnamurti and Velayutham 2018). Moreover, environmental reporting can result in costly lawsuits (Field, Lowry, and Shu 2005). On the other hand, when a firm discloses carbon information voluntarily, investors may take such disclosure as a signal that the firm is committed to carbon-emissions management. In addition, disclosure of emissions may reduce information asymmetry between insiders and stakeholders. In emerging markets, such benefits may not be significant, though, as investors in such markets may not pay as much attention to environmental issues as they do in developed markets, and thus pressure from investors from developed markets and executive compensation mechanisms may play an important role in encouraging firms to disclose carbon information. As such, the results of our analyses emphasize overall the importance of the roles that international governance as well as internal governance and executive compensation mechanisms can play in improving environmental transparency in firms that operate in emerging markets.

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Appendix I. Variable Definitions

Variable	Definition
DisclosureD	An indicator variable that equals one if a firm is a voluntary-disclosure firm and zero otherwise.
ManDisD	An indicator variable that equals one if a firm is a mandatory-disclosure firm and zero otherwise.
ForeignOwn$^{\%}$	Ownership by foreign investors scaled by total ownership by investors.
CrossListingD	An indicator variable that equals one if a firm is listed on foreign stock markets and zero otherwise.
Region$^{\%}$	Foreign investors' shares by the geographic regions (Europe, US, Asia, Africa, or Oceania) in which they are based scaled by total ownership.
OutsideDir$^{\%}$	The ratio of outside directors to total directors.
FemaleDir$^{\%}$	The ratio of female directors to total directors.
ESGPayD	An indicator variable that equals one if a firm adopts a non-financial performance-oriented compensation policy for executives based on ESG or sustainability factors and zero otherwise.
TargetD	An indicator variable that equals one if a firm sets carbon emissions targets and zero otherwise.
Size	The natural log of a firm's total assets.
RETvol	The standard deviation of stock returns over the previous 52 weeks.
Investment	Capital expenditures scaled by lagged total assets.
Leverage	Total liabilities divided by total assets.
Q	The sum of the market value of equity and total liabilities scaled by total assets.
R&D	The ratio of research and development (R&D) expenditures to sales.

Table 1
Summary Statistics

This table displays summary statistics for sample firms. The sample consists of firms with observations for the period spanning 2011–2019. We restrict the sample to KOSPI200. In addition, we exclude financial firms and firms with missing values needed for the analyses. All variables are defined in Appendix I and winsorized at 1 percent on both tails of the distribution.

	N	Mean	SD	Min	p25	p50	p75	Max
DisclosureD	1,510	0.319	0.466	0.000	0.000	0.000	1.000	1.000
ManDisD	1,510	0.470	0.499	0.000	0.000	0.000	1.000	1.000
ForeignOwn$^{\%}$	1,510	0.203	0.157	0.000	0.084	0.168	0.275	0.897
CrossListingD	1,510	0.716	0.451	0.000	0.000	1.000	1.000	1.000
Europe$^{\%}$	1,510	0.060	0.103	0.000	0.012	0.031	0.071	0.878
US$^{\%}$	1,510	0.084	0.080	0.000	0.035	0.062	0.110	0.863
Asia$^{\%}$	1,510	0.039	0.111	0.000	0.000	0.006	0.027	0.998
Africa$^{\%}$	1,510	0.000	0.003	0.000	0.000	0.000	0.000	0.074
Oceania$^{\%}$	1,510	0.000	0.001	0.000	0.000	0.000	0.000	0.021
OutsideDir$^{\%}$	1,509	0.534	0.165	0.000	0.429	0.571	0.667	1.000
FemaleDir$^{\%}$	1,177	0.021	0.060	0.000	0.000	0.000	0.000	0.333
ESGPayD	1,510	0.111	0.315	0.000	0.000	0.000	0.000	1.000
TargetD	1,510	0.250	0.433	0.000	0.000	0.000	0.000	1.000
Size	1,510	21.845	1.410	18.432	20.716	21.721	22.904	24.678
Investment	1,510	0.043	0.062	-0.190	0.009	0.027	0.060	0.487
RETvol	1,510	0.023	0.007	0.007	0.019	0.022	0.027	0.068
Leverage	1,510	0.471	0.187	0.054	0.317	0.483	0.609	0.934
Q	1,510	1.373	0.977	0.448	0.867	1.040	1.477	8.626
R&D	1,510	0.015	0.034	0.000	0.000	0.002	0.014	0.454

Table 2
Correlation Matrix

This table displays the correlation coefficients of the variables used in the analysis. All variables are defined in Appendix I and winsorized at 1 percent on both tails of the distribution. Statistical tests of relationships between variables are conducted for both measurements of correlations. ***, ** , and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

	DisclosureD	*ManDisD*	*ForeignOwn%*	*CrossListingD*	*OutsideDir%*	*FemaleDir%*	*ESGPayD*	*TargetD*	*Size*	*Investment*	*RETvol*	*Leverage*	*Q*	*R&D*
DisclosureD	1.00***													
ManDisD	0.18***	1.00***												
ForeignOwn%	0.33***	0.07**	1.00***											
CrossListingD	0.38***	0.09***	0.29***	1.00***										
OutsideDir%	0.39***	0.20***	0.16***	0.25***	1.00***									
FemaleDir%	0.01	-0.07**	0.05	-0.04	0.01	1.00***								
ESGPayD	0.49***	0.18***	0.18***	0.22***	0.22***	0.02	1.00***							
TargetD	0.77***	0.18***	0.36***	0.33***	0.32***	-0.01	0.42***	1.00***						
Size	0.65***	0.32***	0.32***	0.47***	0.51***	-0.08***	0.42***	0.60***	1.00***					
Investment	0.09***	0.12***	0.10***	-0.02	-0.07***	0.07**	0.04*	0.10***	-0.04	1.00***				
RETvol	-0.12***	-0.14***	-0.27***	-0.07***	-0.04*	0.07**	-0.08***	-0.10***	-0.21***	0.01	1.00***			
Leverage	0.19***	0.13***	-0.15***	0.17***	0.22***	-0.07**	0.13***	0.19***	0.39***	-0.06**	0.22***	1.00***		
Q	-0.01	-0.19***	0.14***	-0.03	-0.04	0.14***	-0.1***	-0.04	-0.32***	0.11***	0.22***	-0.18***	1.00***	
R&D	0.04	-0.11***	0.03	-0.01	0.05*	0.10***	0.02	0.05*	-0.08***	0.03	0.12***	-0.09***	0.22***	1.00***

Table 3
International Aspects of Corporate Governance

This table displays the results of the logistic regressions that examine whether international aspects of corporate governance are associated with voluntary disclosure of carbon emissions. For all columns the dependent variable is *DisclosureD*, an indicator variable that equals one if a firm is a voluntary-disclosure firm and zero otherwise. *ForeignOwn*$^{\%}$ is ownership of foreign investors scaled by the total ownership of investors. *CrossListingD* is an indicator variable that equals one if a firm is listed on foreign stock markets and zero otherwise. Control variables include *Size*, *Investment*, *RETvol*, *Leverage*, *Q*, and *R&D*. All variables are defined in Appendix I and winsorized at 1 percent on both tails of the distribution. Numbers in parentheses are standard errors clustered at the industry level. ***, ** , and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Dep. variable	*DisclosureD*			
	(1)	(2)	(3)	(4)
ForeignOwn$^{\%}$	2.468*	2.607*		
	(1.390)	(1.480)		
CrossListingD			2.077***	2.137***
			(0.665)	(0.684)
Size	2.094***	2.172***	1.963***	2.031***
	(0.321)	(0.333)	(0.310)	(0.322)
Investment	3.571**	3.389*	3.989***	3.898***
	(1.703)	(1.909)	(1.276)	(1.470)
RETvol	-11.797	-6.324	-21.072	-20.123
	(32.063)	(40.389)	(29.557)	(36.444)
Leverage	-1.022	-1.295	-1.262	-1.473
	(2.178)	(2.269)	(1.925)	(2.021)
Q	0.744***	0.738***	0.748***	0.754***
	(0.228)	(0.229)	(0.231)	(0.234)
R&D	9.288**	9.473**	8.990*	9.025*
	(4.736)	(4.823)	(4.693)	(4.827)
Industry FE	Yes	Yes	Yes	Yes
Year FE	No	Yes	No	Yes
N	1325	1325	1325	1325
R^2	0.517	0.530	0.531	0.544

Table 4
Regions of Foreign Investors

This table displays the results of logistic regressions that test whether foreign investors across various geographical regions are associated with voluntary disclosure of carbon emissions. For all columns, the dependent variable is *DisclosureD*, an indicator variable that equals one if a firm is a voluntary-disclosure firm and zero otherwise. *Region*$^{\%}$ is foreign investors' shares by reference to geographical region (Europe, US, Asia, Africa, or Oceania) in which they are based scaled by total ownership. Control variables include *Size*, *Investment*, *RETvol*, *Leverage*, *Q*, and *R&D*. All variables are defined in Appendix I and winsorized at 1 percent on both tails of the distribution. Numbers in parentheses are standard errors clustered at the industry level. ***, ** , and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Dep. variable	*DisclosureD*				
	(1)	(2)	(3)	(4)	(5)
	Europe	US	Asia	Africa	Oceania
Region$^{\%}$	4.807**	0.959	-2.328	-9.607	-110.266
	(2.021)	(2.008)	(2.643)	(28.094)	(79.281)
Size	2.295***	2.230***	2.240***	2.239***	2.275***
	(0.371)	(0.334)	(0.330)	(0.330)	(0.331)
Investment	3.688*	3.417*	3.512*	3.421*	4.264*
	(1.928)	(1.916)	(1.992)	(1.916)	(2.204)
RETvol	-12.626	-15.023	-17.123	-15.981	-15.971
	(38.489)	(37.662)	(37.813)	(37.333)	(36.384)
Leverage	-1.873	-1.669	-1.800	-1.727	-1.757
	(2.186)	(2.159)	(2.092)	(2.128)	(2.079)
Q	0.781***	0.797***	0.809***	0.806***	0.817***
	(0.230)	(0.226)	(0.224)	(0.225)	(0.231)
R&D	9.929*	9.275*	9.026*	9.198*	9.271*
	(5.211)	(5.065)	(5.200)	(5.119)	(5.116)
Industry FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
N	1325	1325	1325	1325	1325
R^2	0.534	0.524	0.525	0.524	0.525

Table 5
Mandatory Disclosure and International Aspects

This table displays the results of logistic regressions that test whether international influence on corporate governance (Panel A) and geographical differences across foreign investors (Panel B) are associated with mandatory disclosure of carbon emissions. For all columns, the dependent variable is *ManDisD*, an indicator variable that equals one if a firm is a mandatory-disclosure firm and zero otherwise. For Panel A, *ForeignOwn*$^{\%}$ is ownership of foreign investors scaled by the total ownership of investors. *CrossListingD* is an indicator variable that equals one if a firm is listed on foreign stock markets and zero otherwise. In Panel B, *Region*$^{\%}$ is foreign investors' shares by reference to geographical region (Europe, US, Asia, Africa, or Oceania) in which they are based scaled by total ownership. Control variables include *Size*, *Investment*, *RETvol*, *Leverage*, *Q*, and *R&D*. All variables are defined in Appendix I and winsorized at 1 percent on both tails of the distribution. Numbers in parentheses are standard errors clustered at the industry level. ***, ** , and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A. International aspect of corporate governance				
Dep. variable		*ManDisD*		
	(1)	(2)	(3)	(4)
ForeignOwn$^{\%}$	-0.355	-0.206		
	(1.865)	(1.906)		
CrossListingD			0.256	0.367
			(0.533)	(0.556)
Size	0.534**	0.510**	0.474*	0.437*
	(0.245)	(0.251)	(0.247)	(0.251)
Investment	3.203	4.718*	3.055	4.602*
	(2.439)	(2.638)	(2.608)	(2.781)
RETvol	-30.640***	-22.670*	-29.646***	-22.000**
	(8.185)	(13.761)	(7.244)	(10.605)
Leverage	2.181	2.357*	2.280**	2.441**
	(1.361)	(1.403)	(1.128)	(1.197)
Q	-0.261	-0.308	-0.287	-0.334
	(0.475)	(0.473)	(0.502)	(0.497)
R&D	-2.900	-4.508	-2.653	-4.224
	(7.494)	(7.650)	(7.125)	(7.318)
Industry FE	Yes	Yes	Yes	Yes
Year FE	No	Yes	No	Yes
N	1327	1327	1327	1327
R^2	0.122	0.145	0.123	0.148

Panel B. Regions of foreign investors					
Dep. variable			*ManDisD*		
	(1)	(2)	(3)	(4)	(5)
	Europe	US	Asia	Africa	Oceania
Region$^{\%}$	-5.976	-3.886	4.359***	-569.157	-208.836
	(4.382)	(4.075)	(1.571)	(1245.976)	(187.448)
Size	0.553**	0.593**	0.533*	0.504*	0.547*
	(0.265)	(0.255)	(0.300)	(0.289)	(0.306)
Investment	4.995*	4.676*	4.628*	4.609*	4.829*

	(2.555)	(2.569)	(2.652)	(2.585)	(2.616)
RETvol	-27.178**	-26.840**	-16.759	-20.613*	-21.462*
	(11.587)	(12.378)	(14.065)	(10.852)	(10.967)
Leverage	2.143*	2.015	2.227*	2.334*	2.300*
	(1.230)	(1.308)	(1.174)	(1.232)	(1.245)
Q	-0.214	-0.243	-0.339	-0.304	-0.304
	(0.451)	(0.443)	(0.490)	(0.505)	(0.502)
R&D	-4.467	-3.983	-3.689	-4.366	-2.850
	(7.848)	(7.097)	(7.257)	(7.600)	(6.787)
Industry FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
N	1327	1327	1327	1327	1327
R^2	0.160	0.151	0.173	0.147	0.149

Table 6
Internal Corporate Governance

This table presents the results of logistic regressions that test whether internal corporate governance is associated with voluntary disclosure of carbon emissions. For all columns, the dependent variable is *DisclosureD*, an indicator variable hat equals one if a firm is a voluntary-disclosure firm and zero otherwise. *OutsideDir*$^{\%}$ is the ratio of outside directors to total directors. *FemaleDir*$^{\%}$ is the ratio of female directors to total directors. Control variables include *Size*, *Investment*, *RETvol*, *Leverage*, *Q*, and *R&D*. All variables are defined in Appendix I and winsorized at 1 percent on both tails of the distribution. Numbers in parentheses are standard errors clustered at the industry level. ***, ** , and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Dep. variable	*DisclosureD*			
	(1)	(2)	(3)	(4)
OutsideDir$^{\%}$	2.308*	2.544**		
	(1.183)	(1.239)		
FemaleDir$^{\%}$			4.820*	5.041*
			(2.601)	(2.619)
Size	2.078***	2.152***	2.085***	2.199***
	(0.333)	(0.344)	(0.292)	(0.310)
Investment	3.686**	3.264	4.772*	5.407*
	(1.725)	(2.127)	(2.494)	(2.798)
RETvol	-19.338	-18.003	-27.655	-6.291
	(31.511)	(38.107)	(35.612)	(40.381)
Leverage	-1.678	-2.018	-1.324	-1.883
	(1.960)	(2.062)	(2.509)	(2.573)
Q	0.810***	0.810***	0.700***	0.659***
	(0.240)	(0.247)	(0.226)	(0.219)
R&D	8.891*	9.023*	8.451*	8.165
	(5.216)	(5.452)	(4.851)	(5.104)
Industry FE	Yes	Yes	Yes	Yes
Year FE	No	Yes	No	Yes
N	1324	1324	1026	1026
R^2	0.515	0.530	0.501	0.517

Table 7
CSR-connected Compensation and Carbon Emission Targets

This table the results of the logistic regressions that test whether compensation schemes and carbon emissions targets are associated with voluntary disclosure of carbon emissions. For all columns, the dependent variable is *DisclosureD*, an indicator variable hat equals one if a firm is a voluntary-disclosure firm and zero otherwise. *ESGPayD* is an indicator variable that equals one if executive compensation metrics are based on ESG factors and zero otherwise. *TargetD* is an indicator variable that equals one if a firm sets carbon emissions targets and zero otherwise. Control variables include *Size, Investment, RETvol, Leverage, Q,* and *R&D*. All variables are defined in Appendix I and winsorized at 1 percent on both tails of the distribution. Numbers in parentheses are standard errors clustered at the industry level. ***, ** , and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Dep. variable	*DisclosureD*			
	(1)	(2)	(3)	(4)
ESGPayD	3.330***	3.429***		
	(1.007)	(0.913)		
TargetD			3.119***	3.193***
			(0.244)	(0.252)
Size	1.951***	2.032***	1.618***	1.703***
	(0.287)	(0.296)	(0.236)	(0.264)
Investment	4.712***	4.267**	2.870	3.488*
	(1.739)	(2.100)	(1.877)	(2.094)
RETvol	-30.614	-33.164	-4.542	10.208
	(27.330)	(33.072)	(33.360)	(39.725)
Leverage	-1.072	-1.328	-1.425	-1.726
	(2.177)	(2.217)	(1.940)	(1.985)
Q	0.852***	0.869***	0.496**	0.473**
	(0.235)	(0.247)	(0.217)	(0.213)
R&D	9.625**	9.864**	6.686	6.272
	(4.792)	(4.821)	(4.313)	(4.564)
Industry FE	Yes	Yes	Yes	Yes
Year FE	No	Yes	No	Yes
N	1325	1325	1325	1325
R^2	0.551	0.567	0.609	0.622